EVALUATION OF CYCLO OLEFIN POLYMER AS SABOT MATERIAL FOR HIGH-DENSITY PROJECTILES

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Abstract

Assuring the integrity of spacecraft and its occupants are a priority in the field of space exploration. Micrometeoroids and orbital debris are one of the primary threats that affect spacecraft materials due to the high kinetic energies involved with hypervelocity impacts. Improvement of projectile launching capabilities prompts the investigation of adequate materials for the manufacturing of sabots able to carry high-density projectiles without catastrophic failure. Polycarbonate (PC) has been the chosen material by the Hypervelocity Team at White Sands Test Facility for sabots on the 0.50 caliber launcher; however, there is a material constraint when the projectile becomes significantly dense and the inertial stresses surpass the yield strength of the sabot material. A new polymer material known as cyclo olefin polymer (COP) was suggested for manufacturing sabots, to successfully shoot the intended high-density projectiles. However, after testing COP specimens it was realized that this polymer is not able to plastically deform and fractures at the elastic limit. Ductility is a crucial property in a sabot material to be able to withstand high pressures and shear stresses due to the setback forces of the projectile. Interest in analyzing several polymer blends between COP, high-density polyethylene (HDPE), linear-low-density polyethylene (LLDPE), and dyna-purge (DP) with different weight percentages arose intending to reach the desired mechanical properties for a sabot material. Another important aspect of the investigation was to compare fabrication processes for trying to implement additive manufacturing in sabots. Injection-molded and 3D printed specimens were compared using the mentioned polymers and blends to study how mechanical properties vary from one process to the other. Additive manufacturing has recently attracted much interest due to its flexible process, design alterations, and faster products. In this investigation, PC, two grades of COP, HDPE, LLDPE, and DP were analyzed using tensile and impact testing to observe the differences in their mechanical properties by each process to discover

a sabot material for high-density projectiles. The experimental details along with the detailed characterization of the materials are presented.

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